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FIRES IN COTTON GINS AND HOW TO PREVENT THEM[1]

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LOSS FROM FIRES IN COTTON GINS

Fires in cotton gins cause a large annual loss in the United States,[2] in some seasons amounting to $1,250,000. Arkansas, Georgia, North Carolina, Oklahoma, and Texas especially suffer great loss. In 1917 the loss from cotton-gin fires in Texas alone was approximately $1,000,000.

CAUSES OF COTTON-GIN FIRES

Fires during the ginning process may be due to a number of causes, such as matches in cotton, static electricity, overheated bearings, friction between the saws and cotton stuck in the ribs, and sparks struck by the passage of metal and other foreign material through the equipment.

TESTING THE MATCH THEORY

Since it was generally thought that most of the fires in cotton gins were caused by matches in the cotton, the following tests were made by Federal investigators during the ginning season in Texas.

One forenoon more than 500 birdseye matches were placed in a load of cotton after about half the cotton had been taken from the wagon. The cotton containing the matches was then drawn into the suction pipe, and started on its way through the gin. No fires broke out in the cleaner, the pneumatic distributor, the feeders, the stands, the lint flue, or the bale. Two small fires occurred in the huller breast, but they were easily extinguished by lifting the breast and smothering the flames.

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[1] This circular is a revision of and supersedes Department Circulars 28, Cotton Gin Fires, and 271, Grounding Cotton Gins to Prevent Fires.

[2] Price, David J., and Brown, Harold H., assisted by Brown, Hylton R., and Roethe, Harry E. dust explosions, theory and nature of, phenomena, causes and methods of prevention. P. 181–190, illus. Boston. [1922.]

At another gin, one afternoon, 38 marked matches were placed in about 600 pounds of seed cotton, in the seed house, and drawn with the cotton into the cleaner. The feeders were shut off, and the cotton was forced out through the overflow. No fires occurred anywhere. Then 47 more matches were added to the cotton on the overflow, and the entire mass was drawn again into the cleaner. This time the feeders were opened, however, and the cotton was fed into the gins in the usual way. Again no fires were observed in the cleaner, the belt distributor, the feeders, the gin stands, the lint flue, or the bale. As in the first test, however, two small fires occurred in the huller breast and were readily put out.

In these two tests nearly 600 matches passed through the two systems without causing a fire anywhere except in the huller breasts. Even there only four small fires occurred.

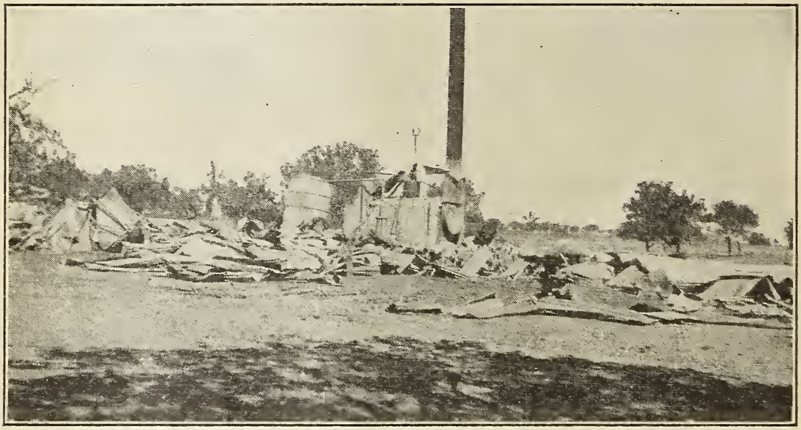


FIGURE 1.—The result of a cotton-gin fire

FALLACY OF THE MATCH THEORY

Since some gins in Texas have reported from 50 to 100 fires a season in years when the fire loss was heavy, it seems fair to assume that five fires to each gin in that State during such seasons constitute a conservative average. That would mean a yearly total of 20,000 fires, of varying magnitude, for Texas alone. Assuming that all these fires were due to the presence of matches in the cotton and assuming further that one match out of every 600 present in cotton can be counted upon to start a fire in the cleaner, where a blaze is far more serious than in the huller breast, fully 12,000,000 matches must in some manner have found their way into the Texas cotton crop.

The crop and climatic conditions in Texas during the 1922 ginning season, for example, make it possible further to refute the oft-repeated statement that matches in cotton cause most of the fires during the ginning process.

If proper allowance is made for the law of averages with respect to the presence of matches in cotton and the existence of average conditions, such as cotton dry enough to burn when brought in contact with a flame, and if there are no other causative factors, the number of fires during the ginning process each year should be uniform. Such is not the case. During the ginning season of 1922 the temperature in Texas was high, and the cotton was exceptionally dry, but there were comparatively few fires. Generally speaking, the cotton was remarkably clean and, in contrast with the conditions prevailing during other seasons when many fires occurred, there were no periods of sustained low humidity, with the exception of one of four days' duration. Matches in cotton are not responsible for the large number of fires that have occurred in some seasons. A more plausible cause must be sought.

STATIC ELECTRICITY THE PRINCIPAL CAUSE OF FIRES

Static electricity is the principal cause of fires during the ginning process. In seasons when the greatest number of fires have occurred electrostatic charges have been abundant and troublesome. At such times the humidity was low, and the cotton being ginned was particularly dry and dirty—conditions ideal and necessary for the formation of charges of static electricity. During the periods when few fires occurred very little static electricity could be detected.

When the humidity is low and the cotton is both dry and dirty high charges of static electricity are common in the unloading and distributing systems, cleaners, and lint flues, and on saw and brush shafts, and practically all belts. These three conditions—low humidity, dry cotton, and dirty cotton—are essential for high electrostatic charges in the gin.

HOW STATIC ELECTRICITY IS PRODUCED

Friction between any two dissimilar bodies produces static, or, as it is sometimes called, frictional electricity. To illustrate:

Many of us, on a day when the atmosphere contains little moisture, have tried the trick of shuffling rapidly over a carpeted floor, then grasping some metal object, thus receiving a distinct electrical shock. What produces this shock? Not the metal, as some have thought, for if the touching is not preceded by shuffling no shock is felt. The friction of the feet on the carpet produces a charge, or a series of charges, of static electricity, which accumulate on the body. Contact with any metal object causes this electricity to be discharged, with a slight shock.

Again, when a comb is run through the hair on a dry day, especially if a rubber comb is used and the hair is perfectly dry, each individual hair seems to stand up alone and refuses to go smoothly into place. This is due to the charge of static electricity generated by the friction of the comb against the hair.

During damp weather, or when the air is moist, a condition is produced that prevents the formation of static charges, or the charges are neutralized or dissipated as rapidly as they are formed. Dry air permits the charges to accumulate until the voltage is high enough to cause a spark to jump to some other body having a lower potential.

Almost every ginner has observed that during periods of drought and low humidity static electricity is present on all metallic parts of the gin. Frequently the first man to notice it is the suction feeder, who receives a shock from the suction pipe. The oiler finds that he receives a shock as he brings the oil can near the bearings, especially those of the cleaner. A man passing beneath a belt often feels his hair rise, and, upon approaching more closely, experiences a prickly sensation, as if someone were sticking pins into him. Sometimes a blue haze plays between the pulley and the belt at the point where the belt leaves the pulley, and sometimes sparks are seen to fly between these objects near the point of contact.

WHAT STATIC ELECTRICITY DOES TO COTTON

A series of tests carried out by the United States Department of Agriculture showed definitely that both seed cotton and lint cotton can be ignited by static electricity, provided the cotton is fairly dry and the sparks are frequent enough. Although the sparks drawn from the belt may not ordinarily ignite the cotton, it is highly probable that a continuous procession of such sparks, which at first char and darken the cotton, will eventually set it on fire. Unquestionably, cotton is ignited by some sparks of static electricity that jump between the metallic parts of the machinery.

Static electricity may also cause fires indirectly. It has been demonstrated that cotton clings to electrified bodies, such as lint flues charged with static electricity, from which it is removed only with difficulty as long as the body retains its charge. Many fires have been traced to the hanging of cotton in the ribs, as well as to the sticking of the cotton to the lint flue and various other places, filling them in such a way as to produce friction, which ultimately causes a fire.

HOW TO ELIMINATE STATIC ELECTRICITY

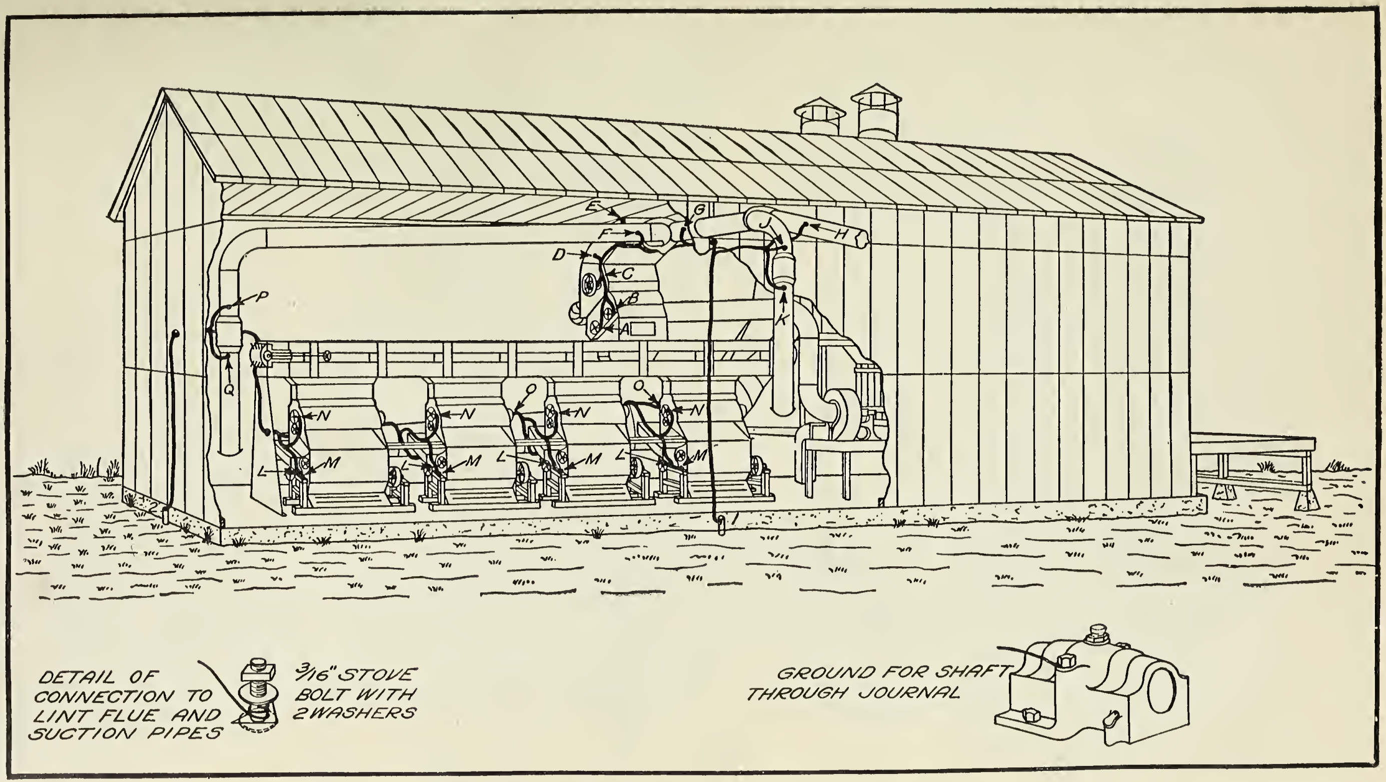
During its investigations the department found that at times static electricity assumed such menacing proportions that the ginners were forced to take steps to remove it from their plants. In some instances it was present in such quantities as to interfere seriously with the operation of the plant, either by making it impossible for the men to touch the machinery or by causing the cotton to cling to the machinery and thus clog the parts. Fires also were very common.

A few ginners removed the static electricity by hanging wet bagging in the buildings, some by wetting down the plant and grounds every day, or even twice a day, and others by injecting a little steam into the suction pipe in the direction of the flow of cotton. A few grounded the machinery. To the surprise of many of the ginners, the effective operation of any one of these methods seemed to put an end to their trouble with fire.

DESIRABILITY OF GROUNDING MACHINERY

For the elimination of static electricity in cotton gins the Department of Agriculture recommends the grounding of the machinery, as shown in Figure 2.

For grounding the saw, brush, and cleaner shafts, a wire firmly seated under the head of one of the journal bolts is adequate. The use of a brush contact, however, will remove the remote possibility that the oil film in the bearing might give trouble as an insulating medium. (Fig. 3.)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DETAIL OF CONNECTION TO LINT FLUE AND SUCTION PIPES
3/16" STOVE BOLT WITH 2 WASHERS
GROUND FOR SHAFT THROUGH JOURNAL

FIGURE 2.—Wiring system for grounding cotton gins

The installation of a good grounding system requires clean, tight contacts and connections. The best of systems, no matter how carefully installed, will be practically useless if not properly maintained. Too often contacts and connections become loose and remain loose, and wires break and are not replaced.

In the grounding system for gins (fig. 2) two ground rods (1 and 2) are used. These rods, preferably of iron (pointed), at least three-eighths of an inch in diameter, or pipe (pointed), about three-fourths of an inch in diameter, should be driven approximately 4 feet into the ground. In dry weather the surface soil around the rods should be slightly cupped out, and water should be poured in from time to time.

Starting with the cleaner, it is advisable to ground each shaft of the boll breakers at *A* and *B*, the shaft of the beater (paddle) at *C*, the screen, top and bottom, at *D* and *E*, the suction pipe (for overflow cotton) at *F*, the suction pipe at *G*, the suction pipe leading to the cotton storage house at *H*, and the unloading pipe at *J* and *K*, above and below the flexible canvas joint.

A good arrangement is to attach a No. 10 insulated wire at *B*, run it along the cleaner and under the Y-shaped union of suction pipes, out through a small hole in the wall near by, and down the side of the building to ground rod 1. Suitable leads of No. 14 insulated wire should be run from appropriate points along this main wire to the various points of contact at *A*, *C*, *D*, *E*, *F*, *G*, *H*, *J*, and *K*.

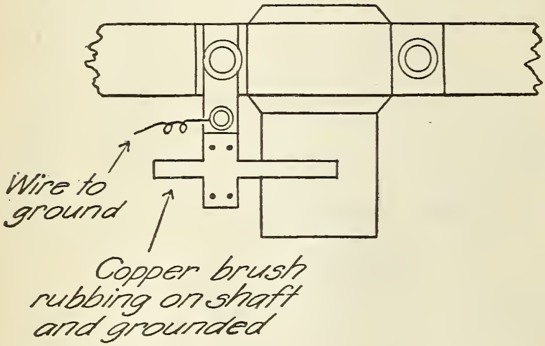

FIGURE 3.—Brush contact for revolving shafts

Contacts should be made also to the brush shaft at *L*, the saw shaft at *M*, and the screen of the cleaner feeder at *N* of each gin stand, to the lint flue at *O* (two contacts), and to the suction pipe (for overflow cotton) at *P* and *Q*, above and below the flexible canvas joint.

A very satisfactory arrangement is to attach a No. 10 insulated wire at *O* (to the horizontal section of the lint flue at the large end), and pass this wire around it in three or four extended spirals to the small end of the flue. At this point the wire should be extended upward to the top of the overflow and of the belt distributor, across to and through the near-by wall, and down the side of the building to ground rod 2. For each gin stand a No. 14 insulated wire should be attached at *M*, extended to *L*, passed upward to unite with a similar wire attached at *N*, and extended to connect with the main No. 10 wire wrapped around the lint flue. A No. 14 wire should connect this No. 10 wire with the lint flue at *O* (between the second and third gin stands), and a similar wire should extend to *P* and *Q* from the main wire at that location.

As an extra precaution it may be desirable to ground the suction pipes and shafts of the various fans.

All connections should be bright and firm. The connection of wires to ground rods and screens should be soldered, those to other wires soldered or taped, preferably soldered. Connections to the lint flue and to the suction pipes should be made either (1) by cutting a suitable triangular hole, inserting a $\frac{3}{16}$-inch stove bolt (head and one washer inside), wrapping the wire around the bolt, and tightly drawing up the nut over a second washer; or (2) by soldering a flat-headed $\frac{1}{4}$-inch stove bolt to the pipe and making the wire firm as in the first case.

Shafts in the cleaner, as well as the saw and brush shafts, may be grounded through their journals by wires firmly seated under the head of one of the journal bolts.

Care should be taken to attach wires to the outer side and at the edge of the screens in the cleaner and cleaner feeders to prevent clogging or choking.

The grounding system here described is designed primarily for a ginning plant using a cleaning separator and boll breaker, belt distributor, and brush gins, but it can be adapted, with slight alterations, to plants having cleaners of other types, pneumatic distributor, and pneumatic gins.

FIRE-PACKED GIN BALES

Fire-packed gin bales, that is, bales into which has passed some burning cotton ignited during the ginning process, cause serious cotton losses. It is recommended that immediately after a fire, the ginner plainly and conspicuously mark the bale that is tied out, regardless of the known or supposed condition of the bale. Some authorities suggest that these bales be identified by a red tag on which the month and day of ginning, as well as the gin, is shown. This identification will act as a warning to the compress yard weigher, the warehouseman, or the railroad agent that such a bale is a suspicious one and may contain fire. Bales so identified should be set aside where they will not endanger property or other cotton.

FIRE PROTECTION

Adequate fire protection in the gin is of great importance. If a fire can be fought in its incipiency it can be readily put out, and little damage will result.

Fire-protection equipment in the gin may consist of water barrels, tanks, pumps, and pails; hose and standpipe connections to a water-pressure system; chemical extinguishers; and steam jets into gin stands, lint flue, cleaner, and pneumatic distributor. Interest is being shown in the use of carbon-dioxide gas as a substitute for steam for fighting cotton-gin fires, especially since internal-combustion engines and electric motors appear to be supplanting the steam engine as a source of power in ginning. Systems using carbon dioxide or other inert gases have been developed for fire protection in other industries, and it may be possible to adapt this method of fire protection to cotton gins.

THIRTEEN RULES FOR PREVENTING FIRES IN COTTON GINS

The cotton ginner can render his plant practically immune from destructive fires if he will—

Thoroughly ground all metal and moving parts of the gin, thus eliminating the static electricity.

Educate the neighboring farmers and cotton pickers to keep the cotton as free as possible from matches and other foreign material.

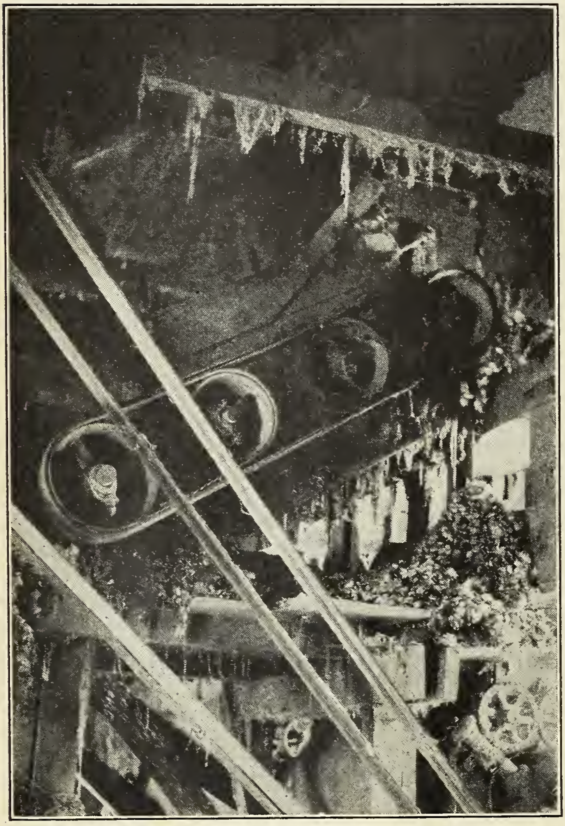

FIGURE 4.—Accumulated refuse around a cleaner and boll breaker is extremely hazardous for the spread of fire

Clean the plant thoroughly at least three times a week, thus freeing the premises from lint, through which fire spreads rapidly.

Refuse to gin wet or even damp cotton, which tends to hang in the ribs and to produce friction.

Keep the huller ribs and the gin ribs as clean as possible, and the saws sharp.

Clean out the condenser every night and immediately after all fires.

Inspect all parts of the plant after closing, lest some hot box or smoldering cotton give rise to a fire.

Use automatic oilers on all bearings, thus preventing hot boxes and the dripping of oil from the boxes on accumulated lint or seed cotton.

Store no baled cotton on the platform or less than 100 feet from any building.

Prohibit smoking and carrying matches in or around the plant.

Keep ample and efficient fire-fighting apparatus easily available at all times.

Keep all machinery in proper alignment.

Mark and segregate fire-packed gin bales.

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